Microsoft® Hyper-V™ R2 on Dell™ PowerEdge™ Blade Servers with Dell|EMC® Storage

Dell | Microsoft

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Introduction

Business Ready Configurations for Virtualization are a reference architecture family of products designed to aid in the ordering, deployment, and maintenance of a virtualization infrastructure. These architectures are designed to meet specific customer needs through the use of various server, storage, and virtualization technologies available from Dell.

The reference architectures defined in this document are targeted at business virtualization needs, although others may also benefit from this architecture. The solution includes Dell™ PowerEdge™ M610 servers, Dell/EMC CX™4 Series storage, Dell PowerConnect™ switches, Brocade Fibre Channel switches and Microsoft® Hyper-V technology, with Microsoft System Center management software. The extensive design and engineering work put into this solution allows customers to quickly and confidently deploy this architecture into production environments, thereby helping to eliminate costly and time consuming trial and error work often encountered during complex deployments.

This guide includes information regarding before and after the purchase of a Business Ready Configuration. Prior to purchase, this information can aid in the solution sizing, licensing selection, and preparation of the solution deployment environment. After the purchase, this guide can aid with the setup, configuration, and deployment of the solution.

Audience and Scope

The intended audience for this white paper is IT administrators, IT managers, and channel partners who are planning to deploy or resell Microsoft virtualization solutions themselves or for their customers. This white paper provides an overview of the recommended servers, storage, software, and services that can be used to plan, scope, and procure the required components to set up a virtualization infrastructure. It is assumed that the reader has a basic understanding of server virtualization (Microsoft Hyper-V preferred), Fibre channel storage, and networking concepts.

Overview

The reference architecture discussed in this paper is centered on Microsoft's latest generation virtualization platform, Microsoft Windows Server® 2008 R2 with Hyper-V (referred to as Hyper-V R2) on PowerEdge M610s and a standard one gigabit network. Virtual infrastructure storage is provided by a single Dell/EMC CX4-120 storage array. Management of the Hyper-V R2 environment is provided by System Center Virtual Machine Manager 2008 R2 (SCVMM 2008 R2) and System Center Operations Manager 2007 R2 that resides on a single PowerEdge M710. All configuration operation requirements are assumed to be in place in the datacenter; some of those may include, but are not limited to Active Directory®, DNS, DHCP, and the existing network infrastructure.

There are three reference architectures available, and vary only in the number of virtualization hosts and the storage capacity provided. A simplified view that covers all three reference architectures is in Table 1 - Hardware Overview.

Table 1 - Hardware Overview

	Entry-Level	Advanced	Premium
Virtualization Hosts (Hyper-V R2)	6 PowerEdge M610	10 PowerEdge M610	14 PowerEdge M610
iSCSI Storage	1 CX4-120 (20 300GB 15k disk)	1 CX4-120 (34 300GB 15k disk)	1 CX4-120 (48 300GB 15k disk)
Network Infrastructure	2 PowerConnect M6220 2 PowerConnect M6348 2 Brocade M5424	2 PowerConnect M6220 2 PowerConnect M6348 2 Brocade M5424	2 PowerConnect M6220 2 PowerConnect M6348 2 Brocade M5424
Virtualization Management (SCVMM 2008 R2, SCOM 2007 R2 and SQL 2008)	1 PowerEdge M710	1 PowerEdge M710	1 PowerEdge M710
Virtual Machines	Consolidation or deployment of up to 95 OS instances.	Consolidation or deployment of up to 170 OS instances.	Consolidation or deployment of up to 245 OS instances.
Solution ID	~~1065436.1~~	1065458.1	1065474.1

NOTE: The virtual machine (VM) counts listed here are based upon VMs with an average of 3 GB RAM and 50 GB shared storage space. Actual results **will** vary.

Table 2 - Reference Configuration Component Overview

Dell PowerEdge Server

- 11th Generation
- Intel® "Nehalem" processor
- Intel QuickPath™ memory technology
- Unified Server Configurator – Lifecycle Controller Enabled
- Remote monitoring and administration

PowerEdge M710 Management Server

- Microsoft System Center Virtual Machine Manager 2008 R2
- Microsoft System Center Operation Manager 2007 R2
- Microsoft SQL Server® 2008

PowerEdge M610 Virtualization Servers

- Microsoft Hyper-V R2 Virtualization Technology

Dell |EMC CLARiiON® CX4

- Expands up to 120 disk drives and 235TB of capacity
- Supports both Fibre Channel and SATA II drives

Technical Specifications

Virtualization Hosts – PowerEdge M610

The PowerEdge M610 servers in all of the business ready configurations are configured identically. Table 3 details the virtualization host server configuration and table 4 details the management server configuration.

Table 3 – M610 Hyper-V Configuration Overview

Item	Detail	Summary
Processors	(2) E5530 Intel® Xeon® processor, 2.4GHz 8-M cache, TurboHT	Two quad core processors
Memory	64-GB memory (8x8GB), 1066MHz dual-ranked RDIMMs for two processors, optimized	64GB total memory
Hard Drive Controller	PERC 6/I RAID Controller Card 256MB Cache, w/ Battery M-Series Blade Servers	
Raid Level/Hard Drives	Raid 1: (2) 73-GB 15-K RPM serial-attach SCSI 2.5-inch hot-plug hard drive	72GB mirrored internal storage that will host Windows Server 2008 R2
BIOS Setting	Performance Setting	
Remote Management Controller	iDRAC6 Enterprise	Provides remote out-of-band management capability
Operating System	Windows Server 2008 R2 Datacenter x64, including Hyper-V	Unlimited number of virtual machine OS licenses.
Onboard Network Adapter Fabric A	Onboard Broadcom 5709 Dual Port 1GbE NIC	The onboard 1Gb adapters will be utilized in the reference architecture for management and cluster traffic
Additional Network Card Fabric B	Intel® Gigabit ET NIC Quad Port, I/O Card for M-Series Blades	4 x 1Gbit adapters provide 4Gbits of available bandwidth and redundancy
Additional Network Card Fabric C	Emulex LPE1205-M 8Gbps Fibre Channel I/O Card for M-Series Blades	2 x 8Gbit adapters providing 16Gbits of available bandwidth and redundancy

Table 4 – M710 Management Server Overview

	Management Server
Base Unit	PowerEdge M710 Blade Server
Quantity of Server	One
Processor	2 x E5530 Xeon processor, 2.4Hz 8MB Cache, TurboHT
Memory	24GB Memory (6x4GB), 1333-MHz dual ranked RDIMMs for two processors, Optimized
Hard Drive Controller	PERC 6/i SAS RAID Controller 2x4 connectors, internal, PCIe256-MB cache
Raid Level/Hard Drives	Raid 10: (4) 146-GB 15-K RPM serial-attach SCSI 2.5-inch hot-plug hard drive
Remote Management Controller	iDRAC6 Enterprise
Operating System	Windows Server 2008 R2, Standard Edition, Includes 5 CALs
Additional Network Card Fabric C	2 x Emulex LPE1205-M 8Gbps Fibre Channel I/O Card for M-Series Blades, Redundant

Design Principles

The following principles were used to design the reference architecture configuration:

- *Ease of deployment:* The physical and virtual design can be easily deployed.
- *Optimal hardware configuration for virtualized workloads:* Contain the optimal hardware configuration to support virtualized workloads. Each PowerEdge M610 blade server is configured with the memory and network adapters required for Hyper-V™ virtualization.
- *Scalability:* Most reference configuration parameters can be configured, either through modification of configuration components (processor speed and memory) or through the addition of components (hard drives and Hyper-V servers).
- *Isolated and high-performance network design:* The network architecture supports isolation of various traffic types required in a virtualized environment. Flexible design enables modification as needed.
- *High-Availability and Live Migration Enabled:* By leveraging Microsoft's Failover Clustering capabilities, virtual machines can move between Hyper-V servers using Live Migration. Live M*igration adds the use of Cluster Shared Volume*s (CSV) that allows a volume to be accessed by all failover cluster nodes. Each node can open and manage files on the volume, and therefore multiple clustered virtual machines can use volumes on the same LUN (disk) while still being able to fail over, or move independently, from one to another.

Architecture

The following sections discuss the reference configuration architecture and design. These sections lay the ground work for the deployment of the reference configuration. A reference configuration overview appears in Figure 1 - Overview
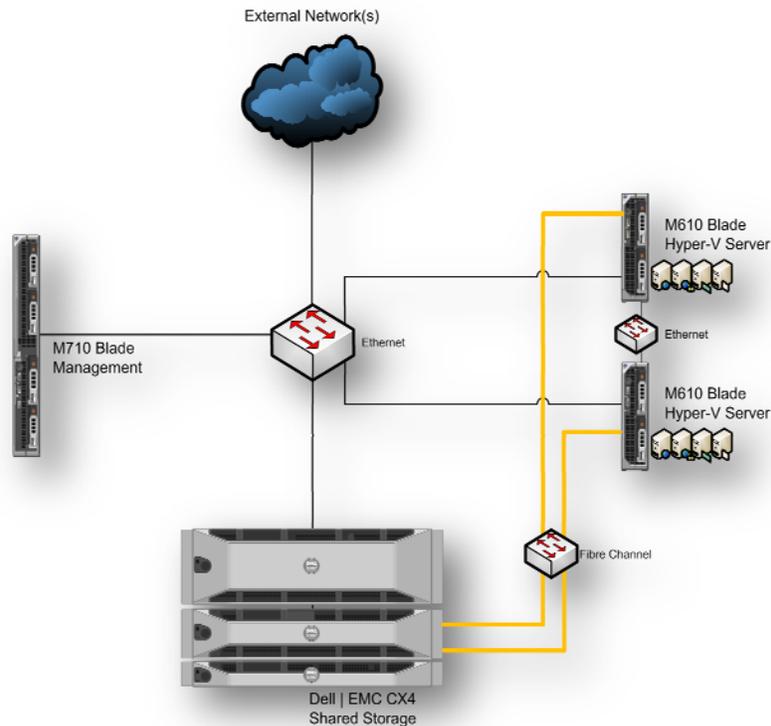
Figure 1 - Overview

This configuration contains Dell PowerEdge servers, PowerConnect network switches, and EMC storage and additional components:

- Networking:
  - Fabric A – 2 Dell PowerConnect M6220 blade switches
  - Fabric B – 2 Dell PowerConnect M6348 blade switches, stacked to create one virtual switch
  - Fabric C – 2 Brocade M5424 fibre channel switches
- Management: Dell PowerEdge M710 running Windows 2008 R2 Standard Edition
- Hyper-V R2 Servers (up to fourteen): Dell PowerEdge M610 running Windows 2008 R2 Datacenter Edition licensed for unlimited Windows virtual machines
- Hyper-V – enabled
- Failover clustering-enabled
- Multi-path I/O enabled redundant Fibre channel network ports
- Redundant cluster private network adapters (used for live migration)

- Redundant virtual machine network adapters
- Dell | EMC CLARiiON CX4-120

Network Architecture

At the heart of the solutions' network configuration are the Dell PowerConnect blade switches. These managed-layer three Gigabit Ethernet switches offer the enterprise-class level performance required for this configuration. The switches use both a stacked and non-stacked configuration. The stacked configuration enables connection redundancy and added bandwidth where required, and as they are both 10 Gigabit uplink capable the design and implementation flexibility needed by advanced users is enabled.

The switch is capable of supporting all configuration networks with the use of VLANs for traffic isolation, and network teaming for redundancy. As mentioned above and as is shown in Table 5 - Network Function Mappings, reference configuration network traffic is broken down by function and assigned to a function-based VLAN and/or switch.

The switch configuration described in the appendix of this whitepaper (Appendix A: Reference Network Configuration) was used during the reference configuration development. Although modifications are possible, this switch configuration serves as the baseline configuration for the white paper since it will support all reference configuration hardware (up to fourteen Hyper-V servers).

Data Networks, Subnets, and VLANs

In keeping with Microsoft best-practice recommendations, Ethernet traffic is broken down into separate networks; each network type is assigned a different network ID, switch or subnet. Sub-netting is used to break the configuration network into smaller, more efficient networks. This also prevents excessive Ethernet packet collision, as well as provides a level of security by using switched-based isolation. Further isolation of network traffic types is achieved by using VLANs and physical isolation by dedicated switches.

As shown in Figure 1 - Overview, the configuration defines the different network traffic types:

- o *Fibre Channel Network* – Used for communication between the Hyper-V servers and shared storage (i.e. EMC CX4-120). This network uses two different switches to enable EMC storage array load balancing capabilities.
- o *Main or Public Network* – Used for OS management connectivity
- o *Cluster Networks* – Two separated networks used for private intra-node communication between Hyper-V servers, and communication coordination when cluster shared volumes and live migration are in use between Hyper-V servers. One network is physically isolated on the A2 fabric, while the other utilizes teamed ports with VLAN tagging.
- o *Virtual Machine Network* – Used for virtual machine connectivity from the Hyper-V servers to connect virtual machines, applications, and services to the rest of the network environment. This network uses two teamed ports.

NOTE: The virtual machine network shares a VLAN with the main/public network. This sharing simplifies the deployment of infrastructure services like DHCP. It is possible to use a separate VLAN for the virtual machine network to further isolate the different traffic types. For more information, refer

to Microsoft's documentation concerning cross-subnet DHCP services.
(*http://support.microsoft.com/kb/120932*).

Table 5 - Network Function Mappings

Network Function	VLAN ID	Switch
Fibre Channel Network #1	N/A	C1
Fibre Channel Network #2	N/A	C2
Main or "Public" Network / Virtual Machine Network	5	A1, B1, B2
Cluster Network / CSV Network	N/A	A2
Live Migration Network	15	B1, B2

This configuration uses static port VLAN assignments to simplify deployment and setup. With this approach, all traffic is tagged (or untagged) with the appropriate VLAN ID when it passes through a network switch port. It should be noted that VLAN tagging can also be performed at the software layer, either through the use of Broadcom's Advanced Control Suite (BACS), the Intel PRO software, or through Hyper-V for virtual networks.

NOTE: Use of software-based VLAN tagging requires changes to the switch configuration listed in Appendix A. Specifically, the hardware port tagging used in the file must be removed, and the port configured to accept pre-tagged traffic; consult the appropriate PowerConnect manual and CLI configuration guide for further information. This information is located on *support.dell.com* in the section for the PowerConnect 6000 family devices.

Figure 2 - Ethernet Switches illustrates both the VLAN tagging and network types as configured in the sample switch configuration file. The file configures the switch's connectivity as is shown in the graphic.
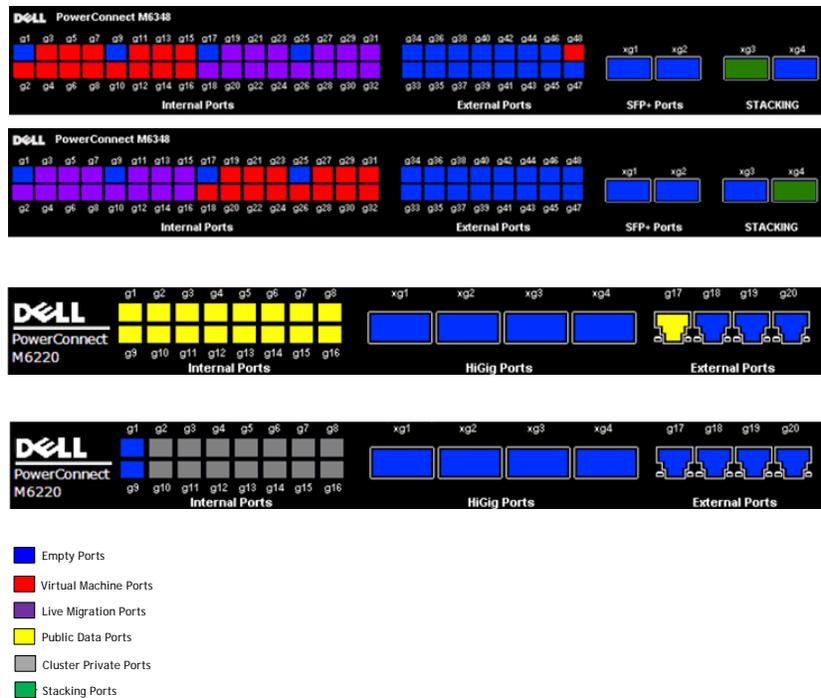
Figure 2 - Ethernet Switches

Virtual Machine Network Connectivity

Virtualization offers the ability to consolidate computing resources to improve management capabilities, improve return on investment of hardware resources, and increase network service availability metrics. Although these qualities are important, they often drive new design requirements that are not present in purely physical environments. One such consideration is the availability of network connectivity provided to the multiple virtual machines on a Hyper-V server. For example, in a non-virtualized environment, a physical network adapter carries the traffic for only one host. A loss of any networking component along the data path will only impact one physical server. In a virtual environment, that same physical networking adapter is carrying the traffic for all the virtual machines running on the host at that time (i.e. - tens of virtual machines). This places an additional burden on the design of the virtual machine network, and highlights the need to reduce the loss of connectivity due to network data path hardware failures.

To lessen this burden, the reference switch configuration uses a VM load balancing team as part of Intel's PRO networking software. This allows for transmit and receive traffic load balancing across VMs connected to the teamed interface. It also provides fault tolerance in case of a switch port failure, cable, or adapter port failure on each of the Hyper-V servers.

Other Network Connectivity

Other networks, such as the Fibre channel, public, and cluster networks, are also critical to the reference configuration and will be covered in later sections.

Uplinks (Off-Rack Connectivity)

Off-rack connectivity is provided by using either the CX-4 10Gbit or the SFP+ 10Gbit uplink capabilities, or the 1Gbit PowerConnect blade switches' external ports. These switches, when connected to the in-rack or core switching infrastructure, provide extensive connectivity into the environment and make them highly configurable. For example, an extensive client-side network can be implemented as needed, and simply connected to the reference configuration network through a PowerConnect switch uplink port for end-to-end configuration deployment. Customers wishing to increase their bandwidth to and from the reference configuration can use multiple 10Gbit uplink cards and cables.

NOTE: The sample switch configuration shown in "Appendix A: Reference Network Configuration" includes configuration of the two PowerConnect switches' uplink ports.

Storage Architecture

The reference configuration uses Microsoft failover clustering to provide high availability of virtual machine resources. With failover clustering, two or more Hyper-V hosts work together to provide the computing resources needed to host virtual machines. This enables virtual machines to move between physical hosts, leveraging the encapsulation provided by Hyper-V virtualization. Because virtual machines can move between hosts, they cannot reside on local (i.e. server) storage that only one host can access; rather, they must reside on shared storage that all Hyper-V hosts can access. This shared storage is provided by a Dell | EMC CLARiiON CX4-120 storage array using Fibre channel drives. This storage device can hold up to 120 physical hard drives, and contains redundant intelligent controllers that provide load balancing and fault tolerance capabilities.

Configuration

This section discusses how the reference configuration components have been designed and configured. Although other configurations are possible, they will not be discussed in great depth. Possible modifications are noted where appropriate.

Dell provides several documents intended to help customers understand, design, and deploy Dell-Hyper-V environments. These documents form the foundation of this reference configuration discussion. It is strongly recommended that these documents be reviewed prior to deploying this configuration. These documents include:

- *Hyper-V Solutions Overview Guide* (http://content.dell.com/us/en/business/d/business~solutions~engineering-docs~en/Documents~sova00.pdf.aspx)
- *Hyper-V High Availability Guide*

  (http://content.dell.com/us/en/business/d/business~solutions~engineering-docs~en/Documents~hsga00.pdf.aspx)

- *Hyper-V Storage Solutions Guide*

  (http://content.dell.com/us/en/corp/d/business~solutions~engineering-docs~en/Documents~ssga00.pdf.aspx)

- *Hyper-V Networking Guide*

  (http://content.dell.com/us/en/business/d/business~solutions~engineering-docs~en/Documents~hyper_network_guide_01.pdf.aspx)

NOTE: These documents do not cover the new Windows 2008 R2 or Windows Hyper-V R2 features. Instead they serve as a reference or guideline for general best practice information for complete virtualized environments. The discussion in the rest of this section is not intended to serve as a deployment plan for the architecture. Deployment check lists are offered below.

Networking

As discussed previously, Dell's PowerConnect blade switches are used for all Ethernet-based reference configuration networking. The use of these switches requires a more complex configuration, but provides redundancy and added bandwidth for business critical applications. The use of stacking provides a simplified deployment, configuration, and ease of maintenance of the configuration. To provide the network isolation outlined previously, the network traffic needs to be divided by using VLAN IDs and dividing it into physical networks.

The reference switch configuration can be broken down into sections:

- VLAN creation
- Per-port definition VLAN assignment
- Uplink port configuration
- Stacking membership

Consult the PowerConnect manuals for more information about the settings in the sample switch configuration file or, on http://support.dell.com.

Servers

Server configuration in the reference configuration requires knowledge of several different vendors including Dell, Microsoft, Intel, Emulex and Broadcom®. While all of these cannot be covered here, this section offers high-level configuration instructions that are appropriate to each server function in the reference configuration. The two server types are:

- Management
- Hyper-V

Server Firmware, Drivers and Updates

Dell offers a simple way to ensure that each server has the latest Dell-approved system and peripheral firmware installed. In the download section for the server on support.dell.com, there is a Dell OpenManage™ utility called Software Update Utility (SUU). Download the utility onto a DVD, and place it into the CD/DVD drive. If the auto-play feature does not launch the utility automatically, then manually launch it. Accept the software's update/installation recommendations; this will require reboot of the server as needed. Once complete, the server will contain the latest firmware and OS drivers.

At publication of this paper, there are Microsoft updates available that might apply to your configuration:

- If you receive a `Stop 0x0000007E` error on the first restart after you enable Hyper-V on a Windows Server 2008 R2-based computer, go to – http://support.microsoft.com/kb/974598
- If you receive a `0x00000101 – CLOCK_WATCHDOG_TIMEOUT` message on an Intel Xeon 5500 series processor-based computer that is running Windows Server 2008 R2 and that has the Hyper-V role installed, go to – http://support.microsoft.com/kb/975530

NOTE: Other hot fixes and/or updates might be recommended by Microsoft; the Microsoft recommendations supersede the recommendations here. It is recommended to install the latest service pack and Windows updates available from Microsoft before enabling any server roles. Any hot fix is intended to correct only the problem that is described within the article. Apply the hot fix only to systems that are experiencing the problem described in the article. The hot fix might receive additional testing. Therefore, if you are not severely impacted by this problem, we recommend that you wait for the next software update that contains the hot fix. Dell does **NOT** support the installation of any Microsoft drivers.

The following table provides a break-down of the minimum driver/firmware version used in this reference configuration. These apply to each server.

Table 6 Driver Firmware Versions

Driver / Firmware	Version
BIOS	1.3.6
SAS/SATA Backplane Firmware	1.07
Broadcom 5709 Driver	14.1.5
Broadcom 5709 Firmware	5.0.12
Intel 1000ET PRO Driver	11.0.103.0
iDRAC Firmware	2.20
Emulex 1205M Driver	7.2.20.6

NOTE: Other options for your server hardware are available from **support.dell.com**, including Repository Manager and updates using the iDRAC interface. For more information consult the driver help section on *support.dell.com*.

NOTE: Be sure to use the latest Dell approved drivers available from *support.dell.com*. To find the latest drivers, browse to the Download page for the system. Dell does **NOT** support the installation of any Microsoft or other hardware vendors' drivers.

Management Server

The reference configuration includes a server to host the System Center Virtual Machine Manager 2008 R2, and System Center Operations Manager 2007 R2 with Microsoft SQL 2008 server software. Although it is possible to run additional software on this server, it is suggested that it be limited to only the software outlined here.

NOTE: If you already have an environment with the System Center products, this server could be removed and additional Hyper-V servers added in its place.

Operating System Installation
If ordered in conjunction with the server, Windows Server 2008 R2 will come preactivated by Dell.

Network Configuration
The server uses a basic 1Gbit network connection. If teaming is needed for your environment, refer to the Broadcom Advanced Configuration Suite (BACS) software Users Guide, on http://support.dell.com, for more information about any switch and NIC requirements.

NOTE: This server **MUST** have a static IP address. Additional network configuration will be necessary if System Center Virtual Machine Manager 2008 R2 is used. Virtual machine library storage can be configured to use the EMC CX4 array fibre channel storage. This would require setup and configuration of the fibre channel controller and network ports on this server that is similar but not identical to the Hyper-V host servers.

Server Feature Activation
This server can be used to remotely manage the failover clustering and Hyper-V services running on the Hyper-V servers. To enable remote management of these servers, install the following remote server administration tools:

- Role Administration Tools-> Hyper-V Tools
- Feature Administration Tools -> Failover Clustering Tools

Management Software Installation
The reference configuration includes Microsoft System Center suite management software. This software can aid in the management, deployment, and monitoring of servers and clients, as well as to simplify the deployment and management of virtual machines.

The management software includes:

- System Center Virtual Machine Manager 2008 R2[1]

- System Center Operations Manager 2007 R2[1]

- SQL Server 2008 (Optional) [1]

NOTE: [1]System Center Virtual Machine Manager 2008 R2, System Center Operations Manager 2007 R2 and Microsoft SQL Server 2008 are software components that can be added at time of purchase, but might require contacting your Dell sales representative for details. Configuration and use will not be covered as part of this document. Consult Microsoft's documentation, on http://www.microsoft.com, on the planning, installing, and operation of the management software present in the reference configuration.

Microsoft® Hyper-V™ Servers
Servers running the Hyper-V role form the center of the reference configuration.

Operating System Installation
If ordered with the server, Windows 2008 R2 will come preactivated by Dell.

Activate the Needed Roles and Features
The following roles and features should be enabled on all the Hyper-V servers:

- Roles: Hyper-V
- Features: Failover clustering and Multi-path I/O (MPIO)

Enabling these roles and features will require the server to reboot a few times; following the required reboots, you can install any recommended hot fixes as noted previously.

NOTE: Other hot fixes and/or updates may be recommended by Microsoft; the Microsoft recommendations supersede the recommendations here.

Network Configuration
The Hyper-V servers require multiple Ethernet ports, and some advanced configuration that is provided by the Broadcom and Intel software. Specifically, each server uses six Ethernet ports – two on the system board and four from the Intel Gigabit ET Quad Server Adapter add-in cards. The Emulex fibre

channel cards are included in the table below, but do not require any special setup or configuration. The following table shows the functional breakdown (i.e. network connections) of these ports:

Figure 3 - Hyper-V Server port mapping
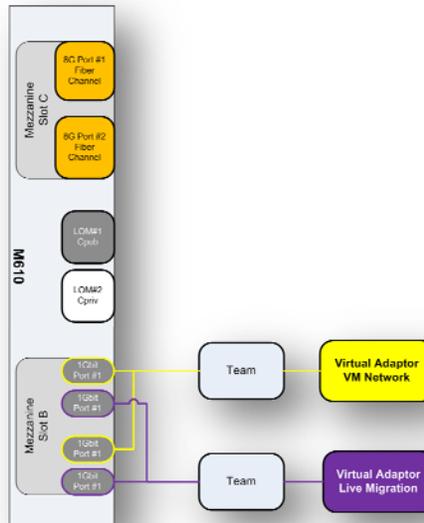
NOTE: All Hyper-V server Ethernet network ports should have static IP addresses, with the exception of the virtual machine Ethernet ports (covered in the Virtual Machine section below).

Consult the Hyper-V Networking Guide for more information on the architecture of Hyper-V's virtual network stack, as well as a discussion of deployment considerations and procedures. Additionally, this guide will aid in the mapping of physical Ethernet ports to Windows-enumerated network adapters, the configuration of virtual switches, and the optimization of Windows server to work with more than one Ethernet connection.

Figure 4 - Sample network naming
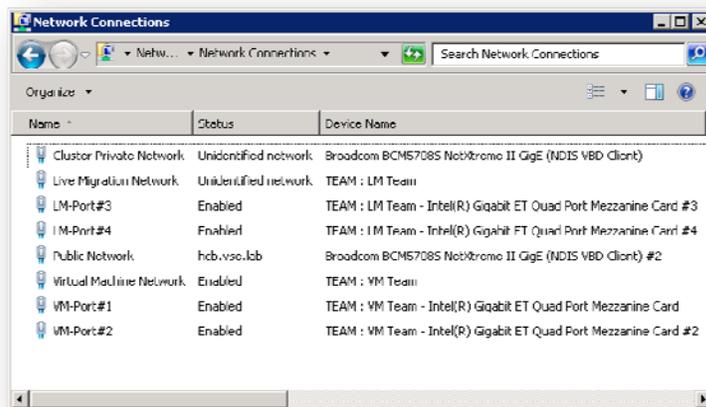
NOTE: Error! Reference source not found. shows the results of configuring a Hyper-V server as detailed in the Hyper-V Networking Guide and network teaming is enabled.

Main or "Public" Network

If using the sample switch configuration file (Appendix A: Reference Network Configuration), the address should be in the 172.20.1.0/24 network (i.e. 172.20.1.12). This network is referred to as the Parent Partition in the Hyper-V Networking Guide and in the configuration file

.
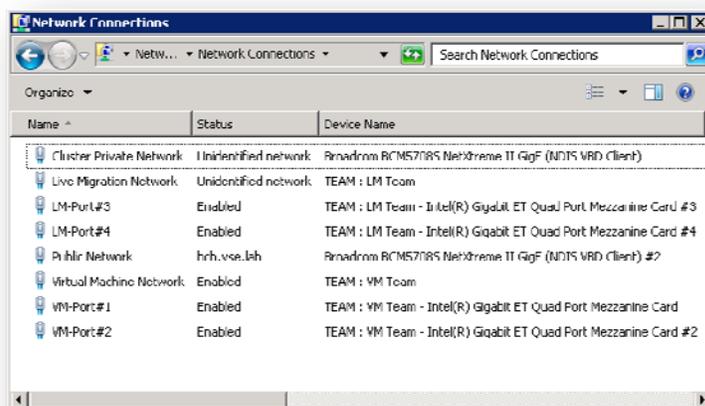
Cluster Network / Cluster Shared Volumes

If using the sample switch configuration file (Appendix A: Reference Network Configuration), the address should be in the 172.30.1.0/24 network (i.e. 172.30.1.12).

Cluster Network / Live Migration

If using the sample switch configuration file (Appendix A: Reference Network Configuration), the address should be in the 172.40.1.0/24 network (i.e. 172.40.1.12).

Virtual Machine Network

The reference configuration uses teaming to provide both network link fault tolerance, and redundancy for the virtual machine connections of each Hyper-V server. This teaming capability also requires the use of third-party software provided by Intel, as well as a special network switch port configuration.

Figure 5 - Virtual Adapter Team Window
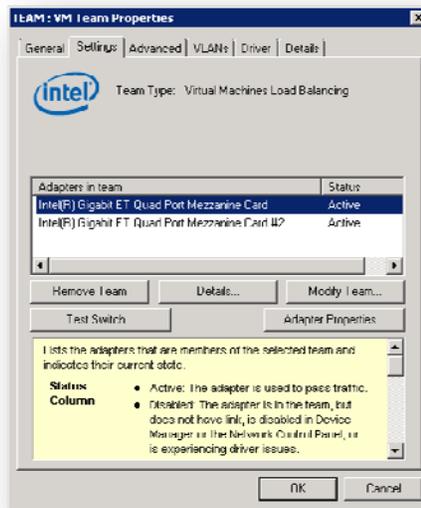
The graphic above shows a configured teaming virtual adapter that is made up of the Intel devices labeled "Intel® Gigabit ET Quad Port Mezzanine Card" and "Intel® Gigabit ET Quad Port Mezzanine Card #2." These adapter numeric references might vary from server to server. They do not need to match across servers, but the port mapping to the PowerConnect M6348 internal port on the physical adapters must be connected to the VM network ports on the reference configuration switch. See below for details on server to internal switch port mappings.

It is important to note that the virtual adapter shown in Figure 3 is not related to the virtual network of Microsoft Hyper-V, although it is used as the outside network connection when creating the Hyper-V virtual switch.

The Dell Hyper-V Networking Guide white paper mentioned previously details how to create a Hyper-V virtual switch on top of a physical adapter. Because network teaming is used in the reference configuration, the Hyper-V virtual switch will be created on top of the Intel network team virtual adapter. The process for this will be the same, for the teamed virtual adapter. Detailed teaming adapter setup steps are discussed in the Deployment section of this document.

Table 7 - Switch Port Mapping

PowerConnect Internal Port Mapping	A1- M6220 port LOM Port #1	A2 – M6220 port LOM Port #2	B1 – M6348 port Mezzanine B Ports #1 and #2	B2 – M6348 port Mezzanine B Ports #3 and #4
Blade Slot #1 / #9	1	1	1,9,17,25	1,9,17,25
Blade Slot #2	2	2	2,18	2,18
Blade Slot #3	3	3	3, 19	3, 19
Blade Slot #4	4	4	4, 20	4, 20
Blade Slot #5	5	5	5, 21	5, 21
Blade Slot #6	6	6	6, 22	6, 22
Blade Slot #7	7	7	7, 23	7, 23
Blade Slot #8	8	8	8, 24	8, 24
Blade Slot #10	10	10	10, 26	10, 26

PowerConnect Internal Port Mapping	A1- M6220 port LOM Port #1	A2 – M6220 port LOM Port #2	B1 – M6348 port Mezzanine B Ports #1 and #2	B2 – M6348 port Mezzanine B Ports #3 and #4
Blade Slot #11	11	11	11, 27	11, 27
Blade Slot #12	12	12	12, 28	12, 28
Blade Slot #13	13	13	13, 29	13, 29
Blade Slot #14	14	14	14, 30	14, 30
Blade Slot #15	15	15	15, 31	15, 31
Blade Slot #16	16	16	16, 32	16, 32

Adding Hyper-V Servers

The reference configuration is designed to support up to fourteen Hyper-V servers; no additional changes would need to done to the blade chassis or switches to accommodate additional Hyper-V servers.

Storage

The shared storage used in the reference configuration is highly flexible, configurable, and expandable.

Shared-Storage Volume Size Considerations

Before you use the Dell | EMC CX4-120, the array must be divided into RAID groups. These groups are made up of physical hard drives with a certain type of RAID configuration. Before they can be used, these disks groups must be further divided into logical unit numbers or LUNs, and must be assigned to a storage group. LUNs must be sized to accommodate not only the virtual machine hard drive (VHD), but also the size of the VM virtual memory and enough space for any VM snapshots.

NOTE: By default, when using Cluster Shared Volumes (CSV), VM snapshots are stored within the CSV on the shared storage. Make sure that enough space is available as the snapshots are created.
The following equation can be used as a starting guideline for sizing shared storage virtual disks:

Required Shared Storage = 1.05 *(Allocated virtual machine RAM + Size of all VHDs + (Space for snapshots))

VM snapshots record differences in VHD data between the previous snapshots and the base VHD file. Snapshots with few changes are roughly 100 MB at minimum. Running out of shared storage **will** cause the VM to pause and not restart until more disk space is made available. The equation above suggests an extra 5% of disk space be allocated to prevent this error.

Array RAID Configuration

The storage array RAID configuration is highly dependent on the workload in your virtual environment. The storage array supports four RAID types— RAID 0, RAID 1, RAID 1/0, and RAID 5.

RAID 1/0 provides the best performance at the expense of storage capacity. RAID 5 generally provides more usable storage, but has less performance than RAID 1/0 in random I/O situations and requires additional overhead in if a drive fails. It also provides the highest storage capacity at the expense of slightly lower performance and availability. A mix of RAID levels may be appropriate, based on the application performance needs running inside the virtual machine. Based on the RAID level chosen, the number of disks could increase or decrease as required to support the number of virtual machines configured.

The reference configuration used RAID 5 with disk groups of five physical hard drives; this allows for one RAID 5 RAID group with one LUN for each of the Hyper-V servers. However, there is no single recommended configuration based on the RAID and LUN mapping; consider the type of application and or datacenter requirements to determine what is appropriate for your environment and needs.

Scalability

The CX4-120 can support up to 8 expansion disk enclosures, with up to 120 total disks. Scaling beyond 120 disks requires that a higher CX4 model array be utilized, such as the CX4-240, CX4-480 or CX4-960. Upgrades from a lower CX4 series array to a higher model is supported if the solution scales beyond initial expectations.

Virtual Machines

When deploying virtual machines, be careful to install device drivers and storage-related OS modifications. The following sections discuss these modifications.

Virtual Machine Drivers (Integration Services)

A Microsoft® Hyper-V™ R2 virtual machine provides an OS with virtual devices; these devices require drivers just like physical servers. These drivers, called integration services, ensure proper usage of the virtual devices and also enable kernel-level interactions of the guest operating systems. These services are available for all supported guest operating systems. A complete list of supported guest operating systems is available (http://support.microsoft.com/kb/954958).

Management

This section discusses several reference configuration management parameters. Each subsection represents a different parameter that is required for overall solution management. We start with a discussion of low-level hardware management options, and end with virtual machine management; this is the order in which the reference configuration should be deployed.

Physical Server Management

The reference configuration is made up of several Dell PowerEdge servers. Although each of the servers plays a different role in the reference configuration, each can be managed in the same manner using both standard and optional server capabilities.

Keyboard, Video, Mouse (KVM)

Each blade chassis ships with integrated keyboard, video, and mouse interfaces that allows for a single entry point for console management of the reference configuration.

iDRAC

The Integrated Dell Remote Access Controller6 (iDRAC6) is a systems management hardware and software solution that provides remote management capabilities, crashed system recovery, and power control functions for Dell PowerEdge systems. The iDRAC6 uses an integrated system-on-chip microprocessor to remotely monitor and control systems. The iDRAC6 co-exists on the blade chassis as part of the chassis management controller or CMC. The server OS executes applications, while the iDRAC6 monitors and manages the server environment and state outside of the OS. Refer to the appropriate PowerEdge server manual at support.dell.com for more information about the iDRAC use and configuration options.

Storage Management

The Dell | EMC CX4-120 features an easy-to-use management interface. This Web interface, Navisphere, enables complete setup and management of the storage array from one interface.

Figure 6 - EMC Navisphere
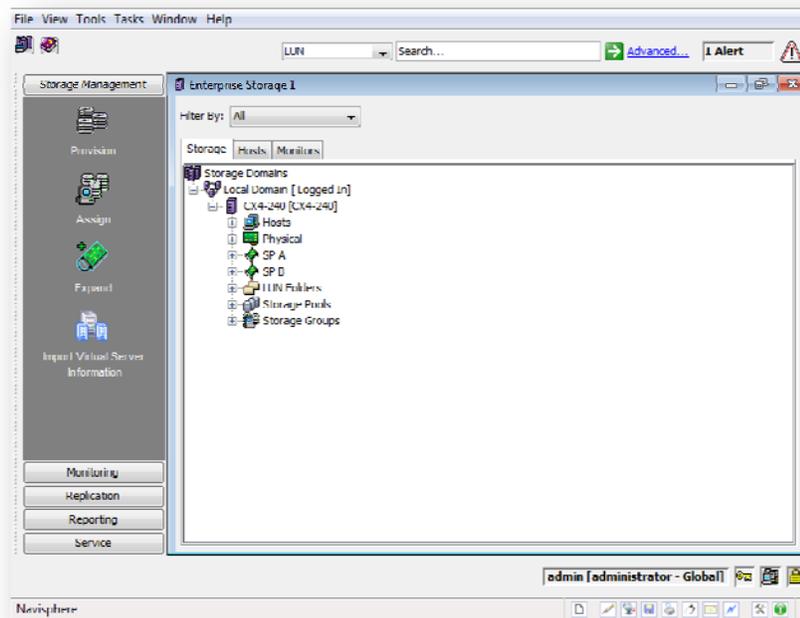
Systems Management

Dell OpenManage: A security-rich Web tool, Dell OpenManage Server Administrator (OMSA) can help customers manage individual servers and their internal storage from virtually anywhere at any time. OMSA is available with a Dell server at no additional charge. The tool:

- Helps to simplify single server monitoring, with a secure command line or Web-based management graphical user interface
- Provides views of system configuration, health, and performance
- Provides online diagnostics to help isolate problems ,or shut down and restart the server (see www.dell.com/openmanage for more information about Dell OpenManage)

Unified Server Configurator (USC): Dell servers' ship with USC, and it helps customers reduce operating costs by simplifying deployment and management. Key features include diagnostics, self-update (UEFI, driver pack update), firmware updates (BIOS, NIC FW, RAID Controllers), and hardware configuration. Refer to the server manuals at support.dell.com for more information about these and other system management tools.

Virtual Machine Management

Microsoft Windows 2008 R2 with Hyper-V has the ability to locally manage Hyper-V servers, with limited cross-server manageability (power on, shut down, and migrate) using the Hyper-V Manager snap-in. For single server Hyper-V deployments, these functions might be sufficient. If multi-server management, rapid virtual machine deployment, and many-to-many administration is required, you can use Microsoft add-on management products such as System Center Virtual Machine Manager 2008 R2. The failover cluster feature provides a single place to manage most of the critical functions of a virtualization environment. Additionally, Microsoft offers management products to aid with health monitoring and life cycle management as part of the System Center suite. More information can be found at www.microsoft.com/systemcenter.

Deployment

This section describes the deployment of the reference configuration. The steps outlined here do not address all possible configurations; rather, they serve as a configuration baseline.

Rack

The configuration requires the use of a rack, preferably a Dell PowerEdge 4220 rack with 42U's of usable space. Planning and setup of the rack and its' components is important. You need a solid foundation in a room with plenty of air-flow, cooling, and electrical supply; weight, cabling, and accessibility must also be considered when planning for an installation of this size.

Network Connections

The reference configuration network connections are kept to a minimum with the use of blade servers and fibre channel storage; most if not all of the network connections are made using the internal network port of the blade PowerConnect switches. The only external network connections are for any uplinks, the iDRAC, and management connections for the EMC CX4 storage array.

Storage Network Connections

Error! Reference source not found. shows how to configure the ports from the Brocade fibre switches directly to the EMC storage array; make sure that each storage processor has a connection to each switch.

Figure 7 - Storage Connections
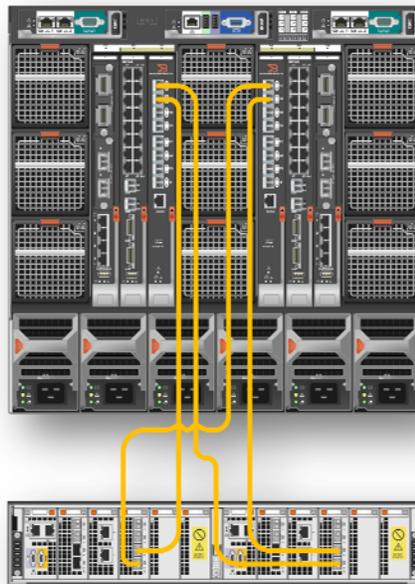
Servers

This section covers the different types of server setup used in the reference solution. Since Dell pre-installs the operating system that task is not covered, and the setup process begins after the OS activation and registration process is completed.

Management Server

1. Using Microsoft Windows Update, install any needed security or program updates to the latest version supported by company policy. If no company policy governing updates exists, make sure to install all of the security updates at a minimum.
2. Run the Dell Server Update Utility (SUU) that came with the Dell PowerEdge M710. If the software is missing from the server box, it can be downloaded from http://support.dell.com. When running the SUU, it is best to update all hardware component devices on the server to latest versions available.
3. Join this server to the domain.
4. For feature Installation, install failover clustering tools as shown below.

Figure 8 - Sample Failover Clustering Console
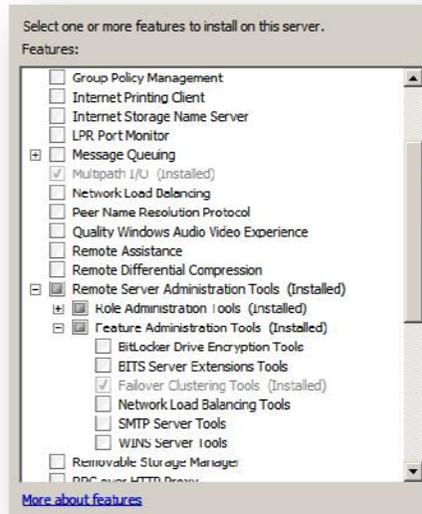
5. Configure the network:
   - Assign the static IP address in the range associated with the proper VLAN. For this server, use an address such as 172.5.1.11.

     Since this server is only used for infrastructure services, no further network configuration is needed.
6. Install any additional software as needed following the manufacturer's recommended setup procedures and guidelines.

Microsoft® Windows 2008 R2 Hyper-V™ Servers

1. Enable server BIOS virtualization technology; for details on making changes to the BIOS, consult the Dell PowerEdge server documentation on http://support.dell.com
2. Using Microsoft Windows Update, install any needed security or program updates to the latest version supported by company policy. If no company policy governing updates exists, make sure to install all of the security updates at a minimum.
3. Run the SUU utility that came with the Dell PowerEdge server. If the software is missing from the server box, it can be downloaded from http://support.dell.com. When running the SUU, it is best to update all hardware component devices on the server to the latest firmware and driver versions available.
4. Install the EMC software (Refer to the EMC User documentation at http://corpusweb130.corp.emc.com/upd_prod_cx4/):
   - EMC PowerPath
   - Navisphere Agent
   - Navisphere Server Utility
5. Install the Emulex driver and software (downloaded from http://www.emulex.com/downloads/dell/dell-lpe1205-m.html)
6. Join this server to the domain.
7. Install the Hyper-V role. After the install has completed, check for any updates to the Hyper-V role available on Microsoft Windows Update.

8. Install the Failover Cluster feature. (See the section on **Failover Clustering** for details on cluster setup and configuration)

Virtual Machine Network Teaming Configuration

1. During the installation of the network driver and software in step 2, the Intel PRO software should have been installed. If it was not, it must be installed at this time to properly configure the networking devices.
2. Configure network teaming for virtual machine traffic and the cluster private team for live migration.
3. Select the Virtual Machines Load Balancing

Figure 9 Intel Network Team Type
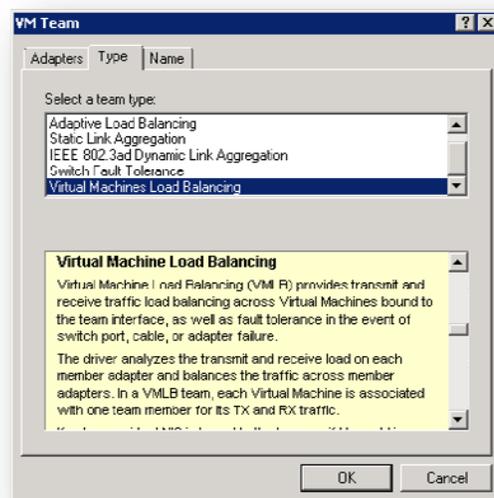
4. Select the Adaptive Load Balancing for the Live Migration team.

Figure 10 - Live Migration team type
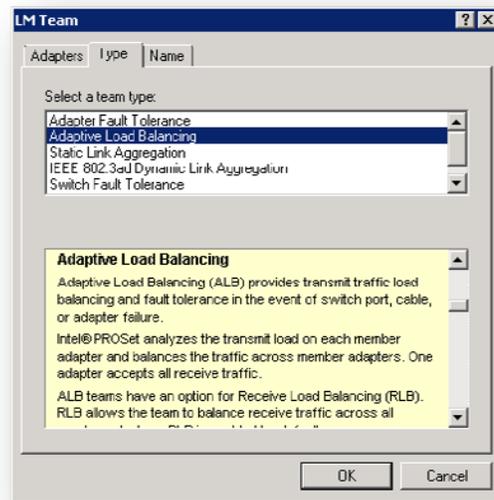
5. When complete your Network adapters should look like the sample in the following figure.

Figure 11 - Network Adapter teams
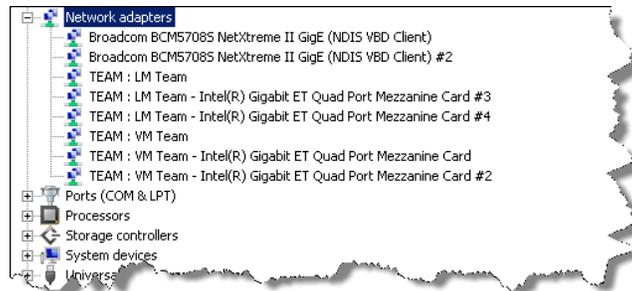
6. Assign static IP addresses in the range associated with the proper VLAN or subnet to each of the virtual adapters and the physical adapters.

Network Teaming Types

There are several different teaming types that could have been used for this configuration. So based on your network requirements other teaming types could be used. This could require configuration changes to the switch(s) depending on which type you select. The types used here were selected based on simple fault tolerance. The live migration type, "Adaptive Load Balancing", was selected because it provides redundancy by automatically failing over from one adapter to the other when either a cable or port fails. For the virtual machine network, the "Virtual Machine Load Balancing" type was selected. This provides both transmit and receive traffic load balancing across virtual machines that are connected to the teamed interface. As with the live migration network, fault tolerance is in place in the event of a port or cable failure.

Note: Adapter Load Balancing is not supported on Hyper-V.

Network Naming

For convenience and ease of setup, it is best to rename all of the devices to names that best reflect their use.

Figure 12 Network Naming
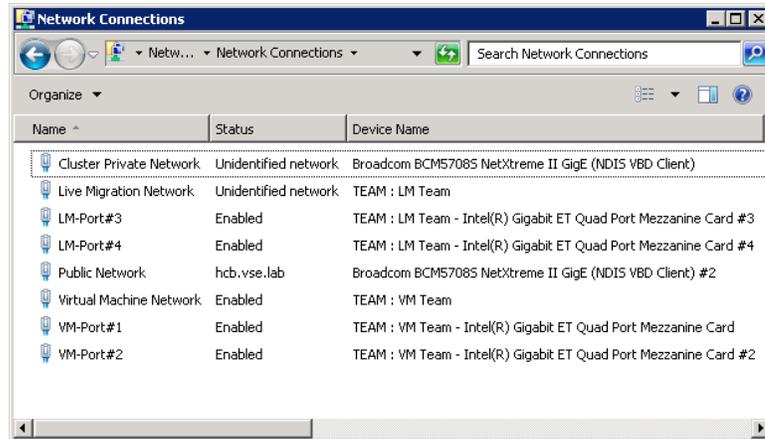
See the Network Solutions Guide for more details.
http://support.dell.com/support/edocs/software/HyperV/en/nsg/PDF/MHSNSGA01MR.pdf

Failover Clustering

After the installation of the failover clustering feature on at least two of the Hyper-V R2 server nodes, you will need to complete the steps below to configure the high availability functionality. These steps are high-level configurations, and might not apply to your needs or environment.

1. Make sure the following items are completed:
   - Make sure all network ports are active and configured with their proper static assigned IP address.
   - Makes sure all nodes in the cluster have access to the shared storage LUNs.
   - Make sure all nodes in the cluster have the same patch/hot fixes applied, as well as driver versions.
   - Run the Cluster Validation Wizard. Consult the Microsoft documentation for further details. http://technet.microsoft.com/en-us/library/cc732035(WS.10).aspx
2. **Configure the Cluster networks; select** names that are meaningful to the type of network traffic as below.

3. Allow clients to communicate with the cluster over the Public connection.

Figure 13 Cluster Network Public
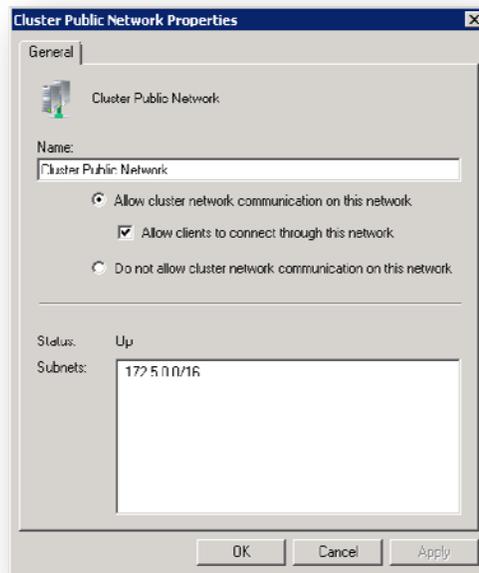
4. Configure the Cluster Shared Volumes (CSV).

Figure 14 Cluster Shared Volumes
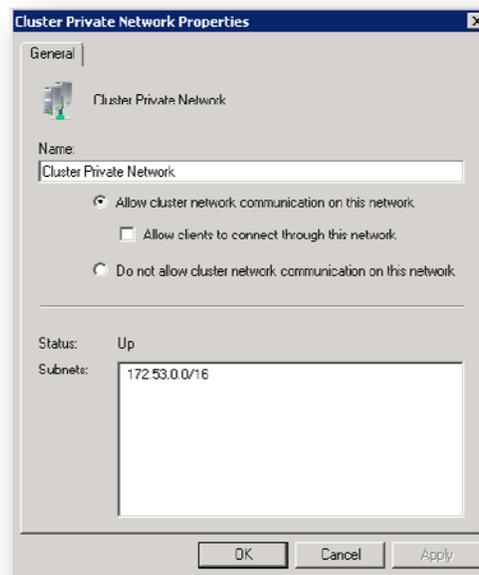
5. Enter the Live Migration Network Preferences.

Figure 15 Live Migration Network Preferences
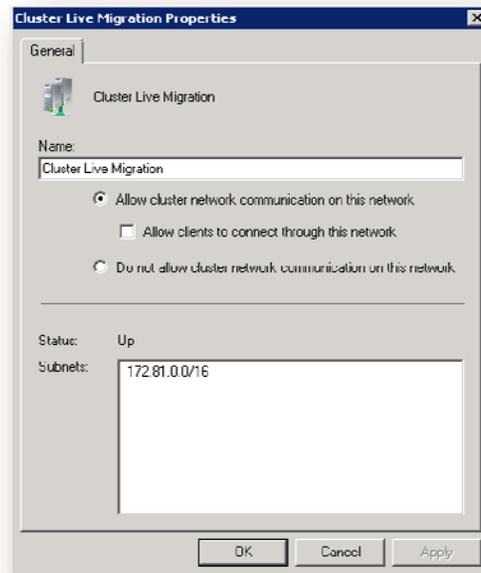
Network

The following section describes the setup of the reference configuration network switch, and the creation of the Hyper-V virtual switch.

Blade Switches

To configure the Dell PowerConnect M6348 / M6220 switches, see the *Dell PowerConnect M6348 / M6220 User's Guide* at http://support.dell.com for more information.

Stacked Switches – Fabric B (PowerConnect M6348)
1. Perform the initial configuration.
2. Confirm that the Dell PowerConnect 6248 switches are running the latest firmware available from http://support.dell.com.
3. Stack the two Dell PowerConnect switches and take note of the Master.
4. Download the switch configuration file found in Appendix A of this document. This can be done from either a serial connection or the web management console.

Cluster Switch – Fabric A2

There is no configuration for this switch, as all traffic on it is in support of the cluster and cluster inter-communication. All of this type of traffic should remain on this switch, with no uplink or external connections necessary.

Public Switch – Fabric A1

There is only a simple configuration for this switch to allow for management and uplink traffic. This switch is used for the public or data traffic for the PowerEdge blade servers, with no virtual machine traffic.

Fibre Channel Switch – Fabric C

Since the reference architecture storage array is directly connected to the Brocade blade fibre channel switches, only a basic configuration is used; zoning was basic, with only a single alias and all Hyper-V servers as part of this alias. If your environment requires the use of intermediate fibre switches, the configuration will need to be adjusted to accommodate this advanced setup. More information on advanced configurations and setups can be found at:
http://www.dell.com/content/products/productdetails.aspx/switch-brocade-m5424?c=us&cs=555&l=en&s=biz.

Virtual Switch

Configure the virtual switch for your virtual machines as shown below. This switch should be placed on top of the VM team that was created as part of the Hyper-V server setup. For more detailed virtual switch configuration information, see the *Network Solutions Guide* found at:
http://support.dell.com/support/edocs/software/HyperV/en/nsg/PDF/MHSNSGA01MR.pdf.

Figure 16 - Virtual Network Configuration
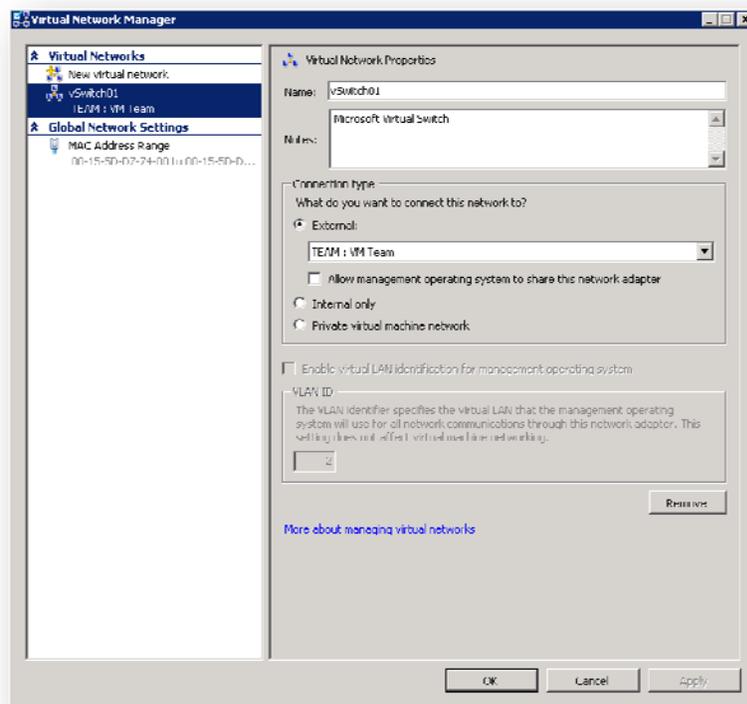
Storage

The Dell | EMC CX4 requires initial onsite setup; once the initial setup is finished complete the steps below to configure the array.

1. Install/Run the Navisphere initialization utility on the management server.
2. Connect to the Navisphere Manager; browse to the IP address of one of the storage processors in a Web browser. **Note**: Java Runtime Environment (JRE) is required to support Navisphere Manager.

3. Set Read/Write Cache settings on the array (recommend providing the maximum supported memory to write cache (775 MB) and splitting the remaining read cache between the two storage processors (486MB each)).
4. Enable Storage Groups on the array.
5. Configure the 8Gbit fibre channel ports as necessary.
6. Enable any optional array-based advanced features that were purchased.

How to Order the Reference Configuration

Dell simplifies the needs of IT customers by offering white papers, reference architectures, and video blogs to aid in the selection, deployment, and maintenance of solutions. In keeping with that methodology, it is Dell's intention to simplify ordering this reference configuration, and to enable configuration as needed to fix the needs of our customers.

This reference configuration can be ordered by using one of the two methods listed below:

- By building the reference configuration from scratch using the information in the Overview section.
- By ordering a preconfigured bill of materials. The solution ID listed in Table 1 - Hardware Overview can be used to select each of the reference configuration variations. This ID will greatly simplify the discussion with a Dell sales representative. The following is a link to all of Dell's business-ready configurations:

  http://content.dell.com/us/en/business/virtualization-business-ready-configurations.aspx

The Dell | EMC CX4 storage array can only be ordered by speaking to a Dell sales representative.

Dell Global Services

Dell Global Services helps customers find suitable virtualization options to reduce the total cost of ownership, speed time to ROI, increase agility, and reclaim IT resources. Today's financial environment dictates that IT organizations reduce costs, while still providing ever-increasing infrastructure services. Dell Global Services believes that by heavily leveraging server virtualization, and increasing the rate of adoption of this technology, you can accomplish this task.

Dell Global Services virtualization consultants work with customers to design and plan around the common virtualization implementation bottlenecks. Our methodology, tools, and processes are designed to speed up the implementation, ease migration scheduling, automate reporting, and provide process transparency. Dell Global Services also offers end-to-end solutions with a single point-of-contact for hardware, software, services, and on-going support. Dell Global Services are focused on IT infrastructure services excellence.

To engage with Dell Global Services, refer to the following Web site: http://www.dell.com/content/topics/global.aspx/services/adi/virtualization_new?c=us&cs=555&l=en&s=biz.

Additional Reading and Resources

Dell PowerEdge Server Documentation and Hardware/Software Updates

For Drivers and other downloads: Visit http://support.dell.com, select "Drivers & Downloads", enter a server service tag or select the server model and operating system version.

For Manuals: Visit http://support.dell.com/support/topics/global.aspx/support/my_systems_info/manuals?c=us&cs=555&l=en&s=biz&~ck=anavml, for option 1 enter a server service tag or choose option 2 and select the component.

Dell PowerConnect Switch Documentation and Firmware Updates

Visit support.dell.com, select "Drivers & Downloads", enter a server service tag or select the switch model and operating system version (Adobe Flash is required).

Dell Virtualization Documentation

Dell TechCenter Hyper-V R2 Blogs/Wiki Site:

http://www.delltechcenter.com/page/Microsoft+Virtualization+-+Windows+2008+Hyper-V+R2

Microsoft® Windows Server® 2008 R2 With Hyper-V™ for Dell™ PowerEdge™ Systems Important Information Guide:

http://support.dell.com/support/edocs/software/win2008/WS08_R2/en/index.htm

Business Ready Configurations:

http://www.dell.com/virtualization/businessready

Dell™ Server PRO Management Pack 2.0 For Microsoft® System Center Virtual Machine Manager User's Guide:

Visit support.dell.com, search for "Dell Server PRO Management Pack". The documentation is included in the zip file that contains the management pack.

Microsoft® Hyper-V Documentation

Hyper-V Getting Started Guide:

http://technet.microsoft.com/en-us/library/cc732470(WS.10).aspx

Supported Guest Operating Systems:

http://support.microsoft.com/kb/954958

Virtual PC Guy Blog:

http://blogs.msdn.com/virtual_pc_guy/default.aspx

Microsoft® Management Software

Microsoft Server Center Operations Manager (SCOM):

http://www.microsoft.com/systemcenter/en/us/operations-manager.aspx

Microsoft System Center Virtual Machine Manager (SCVMM):

http://www.microsoft.com/systemcenter/virtualmachinemanager

SCVMM 2008 R2 P2V and V2V Migration:

http://technet.microsoft.com/en-us/library/cc764277.aspx

SCVMM 2008 R2 Management Pack Guide:

http://technet.microsoft.com/en-us/library/ee423731.aspx

EMC Storage and Software

User Programmable Documentation (Planning, Installation, Maintenance) :

http://corpusweb130.corp.emc.com/upd_prod_CX4/

EMC PowerPath and PowerPath/VE for Microsoft Windows Release Notes :

https://community.emc.com/servlet/JiveServlet/download/11589-4928/PowerPathVE%20Hyper-V%20Release%20Notes.pdf

EMC PowerPath and PowerPath/VE for Windows Version 5.3 Installation and Administration Guide:

https://community.emc.com/servlet/JiveServlet/download/11589-4930/PowerPathVE%20for%20Hyper-V%20Getting%20Started%20Guide.pdf

Intel® Networking

Intel® Gigabit ET Quad Port Mezzanine Card :

http://www.dell.com/us/en/enterprise/networking/nic-intel-gb-et/pd.aspx?refid=nic-intel-gb-et&s=biz&cs=555

Broadcom Networking

Broadcom Driver FAQ:

http://www.broadcom.com/support/ethernet_nic/faq_drivers.php

Emulex Networking

Emulex Quick Start Guide:

http://www.emulex.com/files/downloads/dell/pdfs/lpe1105-m4/lpe1105-m4qsg-screen.pdf

Microsoft® Roles and Features

Introducing Windows Server 2008 Failover Clustering:

http://technet.microsoft.com/en-us/magazine/2008.07.failover.aspx

Appendix A: Reference Network Configuration

This appendix contains a sample network configuration for the Dell PowerConnect 6348 switch used in this configuration. The sample switch configuration will support fourteen Hyper-V servers, a management server, stacking, and uplink to an out-of-chassis switch.

This file includes the setup and configuration options used in the qualification of this configuration. Customers are encouraged to use this file as a baseline for modification to the switch setup and over all configuration architecture. The manuals at http://support.dell.com for the PowerConnect family of switches will aid with modifications to this baseline file.

For more information on Dell PowerConnect switches, see http://www.dell.com/powerconnect

```
! !Current Configuration:
!System Description "PowerConnect M6348, 3.1.0.26, VxWorks 6.5"
!System Software Version 3.1.0.26
!System Operational Mode "Normal"
!
configure
vlan database
!
!  VLAN Definition
!    5: Software/Virtualization Management Network
!   40: Live Migration
!
vlan  40
exit
stack
member 1 1
member 2 1
exit
interface out-of-band
ip address none
ip address 172.10.1.204 255.255.0.0 172.10.1.9
exit
!
ip address none
interface vlan 40
name "LiveMigration"
exit
!
username "admin" password password level 15
flowcontrol
!
!
! The following VLAN 40 define the configuration for cluster private live
migration ports.
!
interface ethernet 1/g18
switchport access vlan 40
exit
!
interface ethernet 1/g19
```

```
switchport access vlan 40
exit
!
interface ethernet 1/g20
switchport access vlan 40
exit
!
interface ethernet 1/g21
switchport access vlan 40
exit
!
interface ethernet 1/g22
switchport access vlan 40
exit
!
interface ethernet 1/g23
switchport access vlan 40
exit
!
interface ethernet 1/g24
switchport access vlan 40
exit
!
interface ethernet 1/g26
switchport access vlan 40
exit
!
interface ethernet 1/g27
switchport access vlan 40
exit
!
interface ethernet 1/g28
switchport access vlan 40
exit
!
interface ethernet 1/g29
switchport access vlan 40
exit
!
interface ethernet 1/g30
switchport access vlan 40
exit
!
interface ethernet 1/g31
switchport access vlan 40
exit
!
interface ethernet 1/g32
switchport access vlan 40
exit
!
interface ethernet 2/g2
switchport access vlan 40
exit
!
```

```
interface ethernet 2/g3
switchport access vlan 40
exit
!
interface ethernet 2/g4
switchport access vlan 40
exit
!
interface ethernet 2/g5
switchport access vlan 40
exit
!
interface ethernet 2/g6
switchport access vlan 40
exit
!
interface ethernet 2/g7
switchport access vlan 40
exit
!
interface ethernet 2/g8
switchport access vlan 40
exit
!
interface ethernet 2/g10
switchport access vlan 40
exit
!
interface ethernet 2/g11
switchport access vlan 40
exit
!
interface ethernet 2/g12
switchport access vlan 40
exit
!
interface ethernet 2/g13
switchport access vlan 40
exit
!
interface ethernet 2/g14
switchport access vlan 40
exit
!
interface ethernet 2/g15
switchport access vlan 40
exit
!
interface ethernet 2/g16
switchport access vlan 40
exit
!
!   Uplink and Stacking port configurations
!
interface ethernet 2/g48
```

```
switchport mode general
exit
!
interface ethernet 1/xg3
switchport mode general
switchport general allowed vlan add 20,40 tagged
exit
!
interface ethernet 2/xg4
switchport mode general
switchport general allowed vlan add 20,40 tagged
exit
exit
```